COVER SHEET

MAPPING FOR FUTURE LAND MANAGEMENT: MAPPING FOR A PROPOSED LAND BOUNDARY RE-ARRANGEMENT IN A RURAL QUEENSLAND CATCHMENT

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ABSTRACT

Geographic Information Systems can offer rural land managers an improved means of capturing, storing, analysing and communicating large quantities of varied information in a timely fashion. Land use planning seeks to promote reasonable and equitable patterns of growth to prevent resource depletion or degradation and to offer options for different land use based on the physical capability of the land parcel. The efficient collection, interpretation and dissemination of land resource information for rural land users provides several important benefits. Providers of rural land information can potentially provide property management planning groups and landholders with the means of using the natural resources base productively and profitable but without compromising any future landholders ability to do likewise.

Modern technology in the form of Global Positioning Systems, Analytical Photogrammetry and Geographic Information Systems can aid in the production of detailed maps and associated rural information products for future land management. This paper provides a brief explanation of research and the developed concepts involved in proposing a land boundary re-arrangement scheme. This paper also draws on recent experiences in developing a small Geographic Information System in a rural landscape over a watershed catchment using a modern technological approach.

INTRODUCTION

It is postulated that the implementation of optimum farming practices is seriously impeded by the inappropriate relationship of property boundaries to the landform. Historically the cadastre was set out on cardinal lines forming squares and rectangles enclosing a given allotted area. It appears that little or no regard was given to the classes or potential of lands enclosed or to the way in which the boundaries dissected the landscape. A quick review of suitably scaled cadastral maps in the Darling Downs area shows that only major natural features became property or district boundaries. For a variety of reasons the cadastral system in rural Australia has come to be regarded as fixed, and disincentives are in place to dissuade landholders, local authorities and conservation advisers from contemplating a re-arrangement of boundaries.

Future directions in property management planning will increasingly require and rely upon various mapping products for communication and documentation of, at times, complex and dynamic, rural land information. Users of such rural information may range from regional land use planners to individual landholders for the purposes of future management of land.

The generalistic concept of re-arrangement of boundaries to facilitate optimum rural land use in the context of a rural Queensland catchment has two primary foci:

(a) To gain an historical understanding of how the boundaries came to be where they are now.

(b) The recognition that there could be developed a viable mechanism for re-arranging property boundaries for more efficient and effective long term usage of the enclosed and surrounding natural resources.

Previous research has been confined to three study areas on the Darling Downs. The first two study areas have been predominantly theoretical studies examining the geometrical and topographical features with minimal field work and no discussions with local landholders.

With funding forthcoming from the Land and Water Resources Research and Development Corporation and Rural Industries Research and Development Corporation, a third project area was chosen to study in detail the existing situation and associated problems created by fixed and inappropriate cadastral boundaries.

This third study area involved a public seminar to float the concept of boundary rearrangement to landholders and interested parties, to create an awareness of the processes of land management practices applied overseas and the probable long term benefits available in an Australian rural landscape (refer Hannigan, Farmer & Webb, 1994b). This also involved a brief study of social aspects and economic viability of local landholders in the project area (refer Byde, 1994 and Jinks, 1994). At an early stage it became apparent that one of the central communication means available was the importance placed on scaled maps and graphical products. From existing problem areas, to locals learning who their neighbours were, and landholders viewing their entire property (and the hydrological catchment) from aerial photography.

This third study project area is the Linthorpe Creek Catchment within Pittsworth Shire which is covered by four 1:50,000 map sheets (refer figure one). It was selected after consultation with members of the Queensland Landcare Council, the Pittsworth Shire Landcare Group and the local landholders. The area is approximately fifteen kilometres by eighteen kilometres in size and is made up of some 130 individual land parcels.

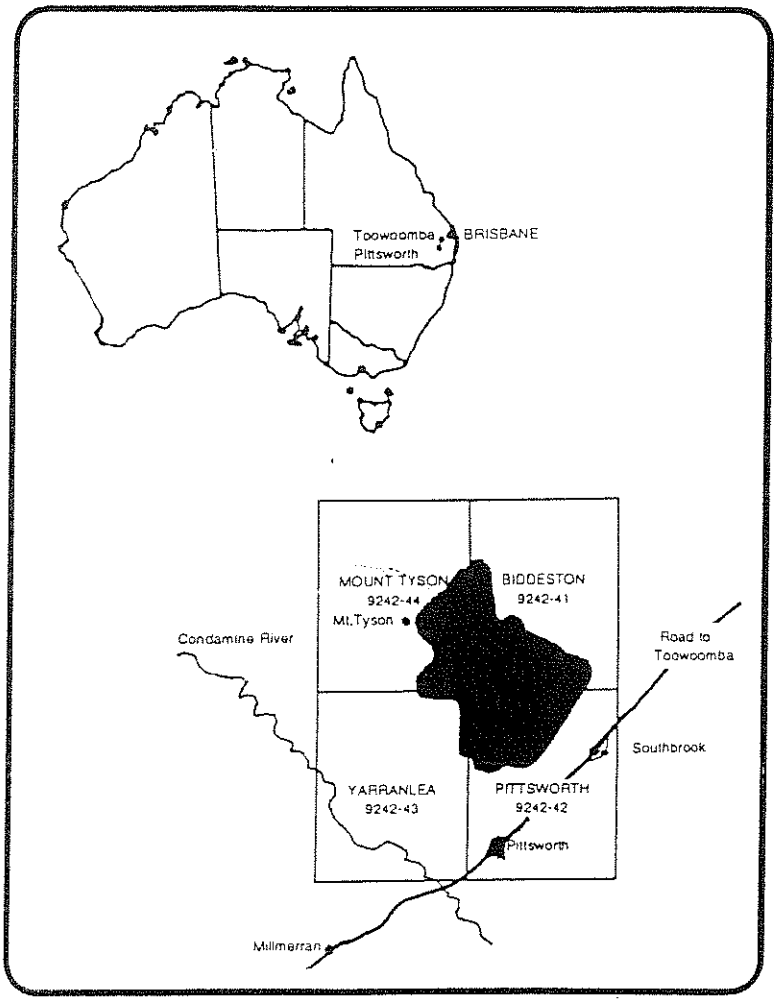


Figure 1. Linthorpe Valley Study Area (diagram not to scale)

THE CONCEPT OF BOUNDARY RE-ARRANGEMENT

Studies have informed us that from about 40 thousand years ago the Australian continent was occupied by the aborigines in a way that fitted their hunter-gather lifestyle. Their cadastre was not fixed and allowed for variations due to changing social and climatic conditions (French, 1989).

The first European settlers were pastoralist squatters who broke out of the "Nineteen Counties" in the 1830's and illegally occupied runs which they structured around water supplies and recognisable landforms (Waterson, 1968)

The formal cadastre as we know it today grew out of the process of achieving security of tenure over these runs. The original tenure of lands on the Darling Downs was leasehold over runs granted under the 1847 Orders-in-Council. A series of Lands Acts from 1860 to 1880 gave squatters "pre-emptive rights" to purchase freehold tenure over set areas within their runs (King, 1957). These pre-emptive purchases were of geometric shapes enclosing a fixed area as set out in keeping with strict directives from the Surveyor-General (Surveyor-General, 1886). They were located to provide tenure over the most valuable parts of the run, i.e. covering improvements etc and also located strategically to provide a monopoly over the non-tenured area of the run, i.e. to cover the water supply (Waterson, 1968). None of the above processes was in any way remotely related to fitting the property parcels to the natural landform nor to creating viable individual farms.

The next phase of subdivision on the Darling Downs was done under the Agricultural Lands Purchase Act of 1894 and the Closer Settlement Acts from 1906 to 1917 (Camm, 1974). This process involved the re-purchase of remaining large runs with re-subdivision and settlement based on the concept of a "yeoman-peasantry", i.e. to create a large number of small independent family farms.

Land areas were kept small to "keep the selector in his place" and estimates of productivity of the land were wildly over optimistic. The areas were again largely subdivided into parcels of 80 - 320 acres -again in squares and rectangles, mostly aligned north-south east-west. Thus by the turn of the century the cadastral system as we know it today was established on the Darling Downs (Camm, 1974). Some amalgamation has occurred since with several parcels being incorporated into a single farm. But the individual parcels are still separate units of title and are still geometrical shapes oriented north and south in contrasting indifference to the landforms.

The road system also became fixed in place by the turn of the century with the establishment of the cadastre. Each portion was required to have legal access. Road reserves were incorporated into the geometrical frame-work with no consideration being given to an efficient communication and transport system, nor to the suitability of the topography for building and maintaining a road.

In the nineteen fifties and sixties the land use underwent major change with broadacre farming replacing the diversified family farm. This had far reaching social and economic effects, as well as impacting on the land resources. The population declined and aged, local economies began to run down, and local services began to withdraw. Commercial operations, schools, public offices, railways, etc., were centralised to the major cities and the industries such as butter factories, became obsolete. Local Authorities' rate bases eventually became seriously eroded, and providing even the basic of services became a burden.

The present settlement on the Eastern Downs is declining (with the exception of Toowoomba and those areas directly influenced by it) with the consequences of falling population, decreasing economic activity and a running down of natural and financial resources. In order to realistically address these problems, nine councils in the region initiated the formation of a regional council - the Eastern Downs Regional Organisation of Councils (EDROC). This Council intends to adopt a regional approach to planning (Walker, 1990). To reverse the declining trend of the settlement pattern and infrastructure. EDROC planning policies need to build new confidence brought about by the re-deployment of resources. This can occur by pro-active planning action, i.e. to zone for land uses which will attract activity and promote changes of land use.

The next area of concern is that of land resource degradation. With the swing to intensive cultivation in the 1950's and 1960's massive soil erosion occurred on the Darling Downs. The technical solutions were quickly to hand, i.e. contour banking, strip cropping, minimum tillage, etc., and the 1960's was an extension phase where farmers were educated and convinced of the need for conservation practices. The problem is now an economic one, with farmers unable or reluctant to invest in conservation farming. Other conservation issues are also of concern. The control of water in terms of quantity and quality is being addressed by the Integrated Catchment Management movement (Qld. Govt., 1991). The Queensland government is currently implementing policies for having an influence over land use in and around watercourses. Environment and Heritage is also a concern with the need for areas to be set aside in some way to create wildlife corridors, retain remnant stands of native vegetation and the need for more tree planting, etc.

All of these issues are seriously hampered by an inflexible cadastral system. If boundaries could be re-arranged and resources re-allocated many of these initiatives could be implemented (Hannigan and Webb, 1992).

Another concern is in the area of rural reconstruction (Osmond, 1985). The function of the Queensland Industry Development Corporation (QIDC) is to provide lending and investment services to Queensland

farming, secondary and territory enterprises. The Corporation's charter is to promote long-term business growth and employment in the State. The approach taken in Rural Reconstruction is to provide financial assistance and incentives to allow farmers to reconstruct their holdings into viable economic units. Those who cannot achieve that objective are encouraged to leave the industry with dignity (QIDC, 1991). Such a mechanism could be used to provide financial assistance to individuals who may wish to participate in a rearrangement scheme.

Another area of serious concern on the Darling Downs is the intrusion of "rural residential" land uses into good agricultural land. Decreasing rural economies are enticing farmers to maximise their capital investment by turning to these types of developments. As well, "historical subdivision" into relatively small parcels is providing a legal framework whereby this type of land use could easily become widespread and seriously threaten the productive capacity of these lands (Capelin, 1993; Morris, 1993).

The existing cadastre is an impediment to change. It is commonly regarded as being fixed. The normal mechanism for changes to the cadastre is via the real estate development process which involves significant costs. In an urban area these costs are accepted because of the betterment of value brought about by the development. In the rural context such a betterment is not large nor immediately tangible.

THE MECHANISM FOR REARRANGEMENT

A possible mechanism for boundary rearrangement is the European process of remembrement. Dowson and Sheppard describe the problem in the "Old World", as:

> Fragmentation is usually the cumulative result of the law of succession over successive generations, causing the land to become so minutely subdivided that its cultivation is no longer an economic proposition ..... and steps should be taken to ..... restore productivity by the redistribution of the holdings.
>
> (Dowson and Sheppard, 1952)

Dowson and Sheppard report that this type of fragmentation is widespread throughout the continent of Europe where a considerable volume of literature, explaining the procedure of adjustment, is on record.

In France and Belgium this adjustment is termed "Remembrement", in Switzerland "Remanaement" and in Italy "Raggruppaminto".

OBJECTIVES OF REMEMBREMENT

> The object of remembrement is primarily to restore the full productivity of the soil by regrouping the holdings into parcels of workable size and shape. (Dowson and Sheppard, 1952).

The objectives for most European legislation relating to land consolidation is to bring about efficiencies in the social and economic spheres and to manage a range of environmental issues. Tenkanen provides the following summary of legally defined aims and objectives in European land consolidations legislation:

1. To improve the preconditions for efficiency in agriculture and possibly forestry (e.g. Austria, France, Italy, Madagascar, Poland, Switzerland and Yugoslavia).
2. To improve the preconditions for efficiency in agriculture and to protect and improve natural sites (e.g. Belgium and Slovakia).
3. To improve the production and working conditions in agriculture and possibly forestry and to promote other legally planned land use in rural living and working space (e.g. Germany).
4. To improve the layout and structure of the rural area in accordance with the functions (agricul ture and forestry, nature and landscape, infrastructure, open air recreation and cultural history) of the area concerned, as these are specified within the framework of (regional) land use planning (Netherlands).

(Tenkanen, 1994:5)

Ideally the process should set out to achieve a "win/win" situation. A waiver of fees and charges associated with the cancellation and issue of title should be a feature of the legislation. The key component of the remembrement operation is valuation - an accurate valuation of each holding before, and a realistic assessment of the value of the new parcel.

The objectives and aims of a particular piece of land consolidation legislation are usually implemented in the following steps:

(1) Plans of existing area is prepared;
(2) Schedule and inventory is prepared of existing owners, encumbrances and assets, etc;
(3) Subject area is valued;
(4) Subject area is redesigned;
(5) A land reallocation proposal is prepared;
(6) A period of time is allowed for inspection/objection to the proposal (often done throughout the process);
(7) Finalisation of conveyancing, transfers, etc. (Hannigan and Farmer, 1995)

The key features of such a scheme would be:

(a) it would have to be "bottom-up" in approach, i.e. the individual landholders collectively approach an authority and ask for it to be done. The Landcare movement could be the vehicle for such an approach;

(b) the scheme is worked out in close co-operation with all parties and government instrumentalities. This could be done at a suitable scale as part of a Farm Plan or Project Plan under the statutory provisions of an Act, such as the Queensland Soil Conservation Act of 1986, and/or in conjunc tion with a Local Authority Planning Scheme (refer Capelin, 1989);

(c) the scheme is publicised widely and provision for objections set in place.

Finally, the Authority implements the scheme. Government and Local Authorities could be expected to nurture, support and subsidise the scheme because it would be achieving government's conservation, social and economic objectives.

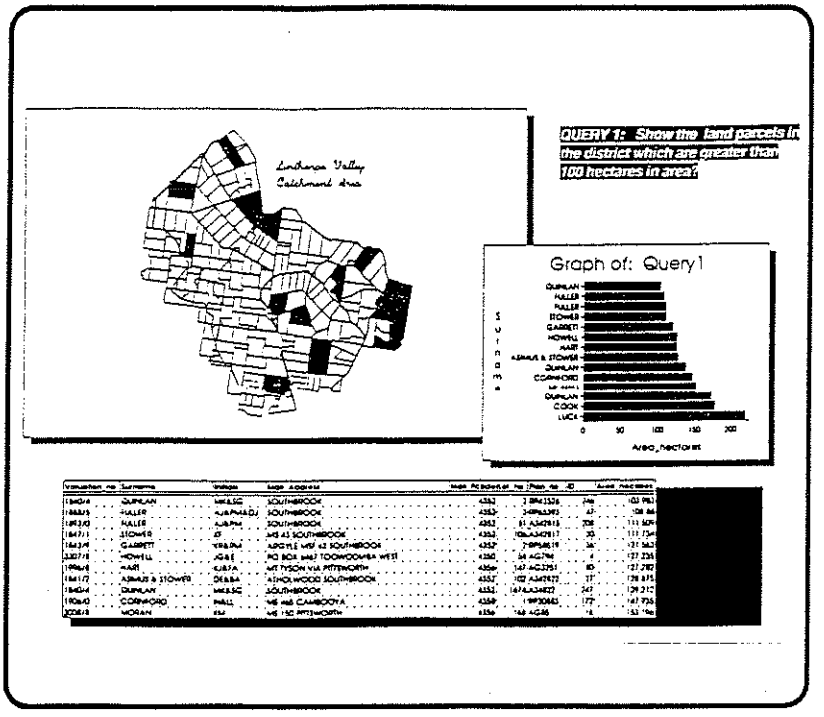


Figure 2. Typical GIS inquery output

A proposed model for the study case is a refined version of the European process for rearranging farm boundaries and consolidating land and is therefore a process which is considered more suited to some Australian circumstances. It represents the outcome of the fine tuning during, and subsequent to, the testing of the original European ideas in the study area. This customised model in effect represents what may be considered the optimum or most effective legislative and administrative framework for farm reconstruction and boundary rearrangement in this country.

The structure of this model recognises that Australian policy, legislation and procedure operates within the context of a three tiered system of government, i.e. Federal, State and Local (refer Hannigan & Webb, 1996). Hence, the model extends from the broad funding and policy sphere at the Federal level, down to a specific scheme or project implementation sphere at the local and individual property planning level.

In light of the institutional barriers evident at the State level, the land consolidation model proposed for Australia suggests that an appropriate piece of State enabling legislation be enacted. This State enabling legislation would authorise the establishment of some form of State Consolidation Authority. There are several options for the establishment of an authority such as this. The government could establish a completely new authority, or it could extend the jurisdiction of some existing department. Regardless of how or in what form this proposed authority exists it would act in a supervisory capacity and administer the relevant piece of State enabling legislation. It should also be responsible for administering the Federal funds that would be allocated from time to time.

The proposed piece of State enabling legislation could very well be similar in structure to the German legislation described in Hannigan and Farmer(1995), section 5.3. This piece of legislation is a good example of what may be achieved in the way of policy integration and the setting up of a wholistic framework for implementing farm reconstruction and boundary rearrangement. The legislative changes proposed at the State level represent not so much a radical shift in thinking but rather a streamlining of existing land policy, legislation and procedures. The significant and most difficult step, is to link all these apparently disconnected policy components.

COMMUNITY CONSULTATION

For policy to effectively translate into a physical reality, a community consultation feedback loop is absolutely essential. Community consultation is a well established feature in much of the planning that is currently being done in Australia. (refer Wilson 1992) Rights in property are usually strongly defended and any omission of rights of consultation, objections and appeals etc during the implementation process would be a gross injustice. The emphasis at this level must therefore be on effective communication as a basis for action, reaction and interaction by key stakeholders for a successful physical rearrangement of the land.

There are several options that the Australian government could use for implementing boundary rearrangement at the project level. It could delegate the responsibility to any existing local authority, or some existing statutory authority that has experience with project planning and design matters. The actual scale of implementation that may be carried out could vary also. A project could range in size from the amalgamation of several farms up to a relatively large catchment or sub-catchment area. (refer Figure 3) A closer examination of the German land consolidation legislation described in Hannigan and Farmer (1995), section 5.3 which clearly demonstrates the sort of flexibility that may be incorporated into the process. The German authorities have used this mechanism for everything from a simple exchange between two landowners; to managing the impact of large infrastructure projects, to a comprehensive physical rearrangement of a considerable area of land such as a local authority district.

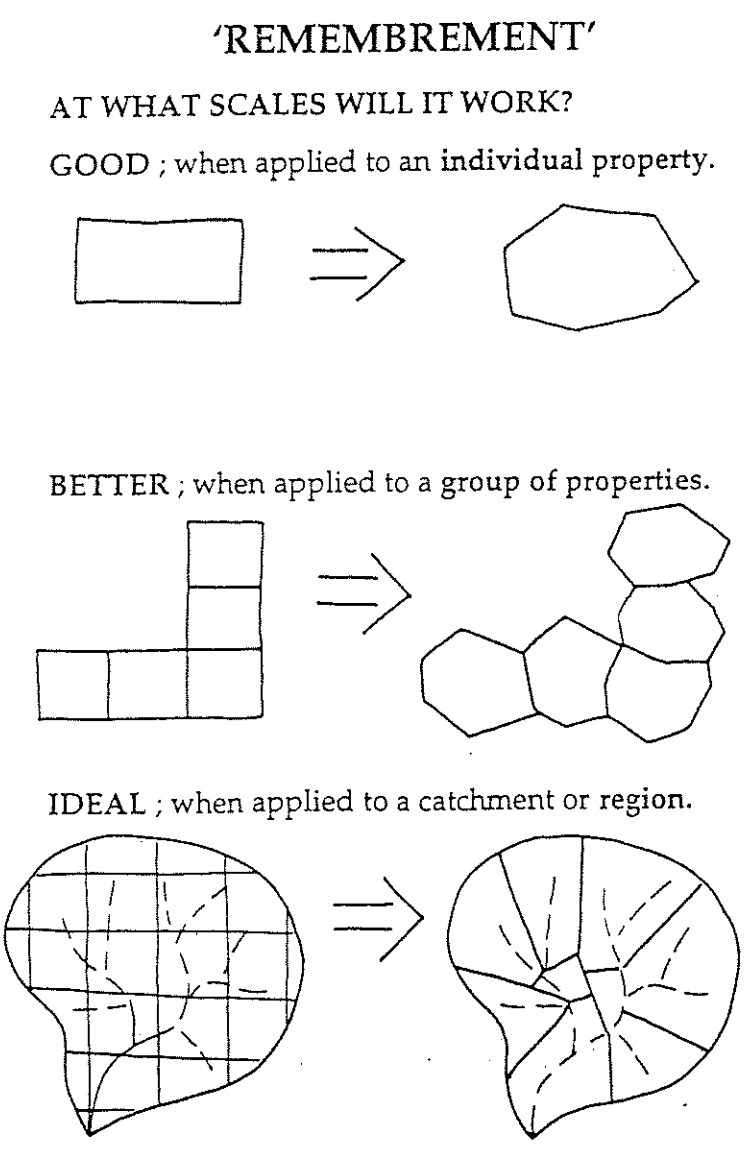


Figure 3. Scales of application

BENEFITS OF IMPLEMENTING REMEMBREMENT' IN THE AUSTRALIAN CONTEXT

The benefits that would accrue by implementing the concept of remembrement' combined with the adjustment of cadastral boundaries, land capability planning, statutory planning controls, whole farm planning and integrated catchment management all supported by appropriate funding and financial incentives would most likely be in the form of the following points.

(I) The facilitation of ecologically sustainable farming through the more effective implementation of whole farm planning which would extend across an entire catchment or group of farms rather than being restricted to a particular property with inappropriate existing boundaries.

(ii) Continue to allow the process of farm rationalisation and amalgamation to occur within a dynamic market context and yet be linked to the need for establishing a sustainable biogeographic system.

(iii) Permit a rationalisation of the rural infrastructure both in the public domain eg roads, culverts etc and a clear reduction in private farm fencing.

(iv) Enable planners to more clearly identify the issues of equity of welfare because a grass roots' approach which the concept of remembrement involves, allows everyone in the project area and interested parties to participate in the planning process.

The methods of reallocating land resources and re-arranging boundaries may be adapted and modified from schemes such as applied in Germany, to suit the special needs of the Australian rural landscape. The application of the concept in a rural Australian context must have a bottom-up approach whereby farmers are assisted to reconstruct their holdings into viable economic farming units, and those who cannot are assisted out of the industry. The concept would also allow the rural cadastre to be redesigned so that the farm boundaries are more in harmony with natural boundaries and landforms.

The objective of sustainable farming would be more easily facilitated because the concept of remembrement' would extend over an entire catchment or group of farms. This would enable the principles of whole farm planning in its most complete sense involves a reorganisation of the farm resources so that there is both internal and external harmony with natural boundaries, landforms and ecological flows eg farm fencing both internal and on boundary would no longer need to cross contours and contribute to erosion problems. This reallocation of resources and boundaries would also allow land to be grouped according to its particular capability which is strongly aligned with the principles of whole farm planning and ecologically sustainable farming. These measures combined with some form of statutory planning controls would also help prevent the intrusion of rural residential development into prime agricultural land.

Mapping Aspects for Future Land Management In rural areas very few original survey marks remain and boundary reinstatement relies heavily on the position of boundary fences. In areas of broadacre cultivation, including cane lands, animals are usually not regarded in the farming strategy and fences are being removed. In these areas, reinstating the old original boundaries could be an expensive problem. Under a rearrangement scheme the old boundaries would largely be ignored and replaced by new ones fixed permanently by global coordinates. State and local governments are also confronted with the need to upgrade the accuracy of spatially related boundary corners in land information systems. A by-product of the rearrangement process is an accurate cadastral data-base over the project area or district.

Geographic information systems were early recognised as being essential to the analysis and communication processes with a basic GIS being established over the trial project area. The Linthorpe Valley study area was constrained to using a low cost approach for data collection, storage, and mapping outputs. A low cost geographic information system was constructed covering the project area with prioritised information themes. It is operated in a PC environment and is based on AutoCAD and MapInfo software. Various information themes were collected from State Government digital databases, supplementary information obtained from digitising of hardcopy plans, and data collected directly in the field using GPS positioning technology (refer Hannigan and Webb, 1993 ;Webb, 1994).

Several important issues are related to mapping for future management of land resources in the next millennium. With rapid advances in technologies in data capture both in the field and remotely; data analysis of complex and varied data sets; modelling, representation and presentation of the Australian rural environment, proposals such as this boundary rearrangement will become more efficient and cost effective to undertake. Because of the nature of this medium to long term implementation phase, it will be necessary to document and map change of the rural environment and determine if positive progress is evident during and after implementation.

Most often the users of maps want to have a clear depiction of the real situation of the landscape they represent, with the user extracting information for their own purpose. Thus, they expect to be able to use the map product without much prior knowledge on how to read and derive information in a simple manner. Mapping products provide the communication of proposed changes via a graphical interpretation approach to condense and/or summarize the larger reorganisation conceptual approaches. This may ultimately be extended down to an individuals rural living and working space (refer to a selection of maps at end of paper).

Conclusions from the farm reconstruction and boundary rearrangement research relating to mapping activities

have shown the following:

- Simple maps products provide an existing status of land information to the local landholders.
- GPS and Photogrammetry technologies can potentially provide a rapid data collection phase of mapping existing features to an appropriate accuracy suitable for management of rural assets.
- GIS technology provides the vehicle to map and effectively communicate change in the district.
- GIS is a management tool to facilitate the mapping, planning and design process of rearranging farm boundaries.
- Map products of various forms allow land managers and advisers to synthesis the information presented and make better informed decisions.

The process of re-arrangement can now be seriously considered in a surveying and mapping sense because of the advance of new technologies. Photogrammetric measurement techniques and/or the use of satellite based Global Positioning Systems (GPS) would now allow for boundaries/ features/ attributes/ visual landscapes etc of a large catchment to be easily and quickly measured and recorded. State land departments are likely to support such a boundary rearrangement scheme because of the need to maintain a rapidly degrading cadastre.

CONCLUSIONS

The research to date indicates that the supposed permanency of the cadastre is a serious impediment to the implementation of sustainable land practices, the rationalisation of infrastructure and services, and the reconstruction of rural industries. It remains to advise and promote to Australian planners of this reorganisation option and to convince the appropriate authorities that it is possible to amalgamate together in a combined land management approach to collectively achieve the seemingly individual aims.

When European concepts were adapted and tested in the Linthorpe Valley study area, it was possible to demonstrate that the problems and issues described in relation to boundaries were present in the study area in some general form (refer Hannigan and Webb, 1995). The study area was assumed to be a typical Australian rural area that has had social, economic and technical problems caused by or compounded by its configuration of boundaries. From preceding research it has been shown that these problems identified for the study area could be repaired by redesigning the boundaries.

A proposed redesign concept gave the farmers, in a hypothetical sense at least, an increased understanding of viable farm sizes and greatly reduced ecological conflicts. The understanding and responses provided by the farmers was not altogether unexpected although at times less than enthusiastic. These responses are comparable with the European experience when re-arrangement schemes for an area are first suggested. Accordingly, as the schemes were implemented and farmers were finally able to see the benefits of farm reconstruction and boundary re-arrangement demonstrated before them they became more enthusiastic towards the concepts of land consolidation.

Landcare groups are increasingly see the need to understand the degradation problems which transgress farm property boundaries. New mapping technologies in the various forms of remote sensing, GPS and GIS can provide the Landcare groups with an avenue of collecting rural land information at a suitable accuracy level. Many GIS projects have shown that they can be used as a management tool to analyse geographically related data, and the associated attributes, which relate to the rural farm landscape. Those in the mapping sciences have an important role to play in providing the expertise related to the new mapping technologies.

REFERENCES

Byde, P. (1994) Social Aspects & Perceptions Concerning Property Boundary Rearrangement. Report prepared for QUT, School of Planning, Landscape Architecture and Surveying.

Camm, J.C. (1994) Dairying on the Darling Downs, 1890-1914: A study of agricultural success. Queensland Heritage. Vol.1. No.10, May 1974, 15-16pp.

Capelin, M (1989) Present Local Planning Approaches to Agricultural Land-Uses in Queensland. Planning Methodology and Operational Guidelines. Research Project. Department of Geographical Sciences, University of Queensland, August 1989.

Capelin, M. (1993) Protection of Good Quality Agricultural Land. Proceedings of a Rural Residential Seminar, Hodgson Creek Catchment Committee and Environment Institute of Australia, Toowoomba, August, 1993.

Dawson, Sir E. and Sheppard, V.L.O. (1952) Land Registration. Her Majesty's Stationery Office, 1952.

French, Maurice (1989) A History of the Darling Downs Frontier. 1. Conflict on the Condamine.

Hannigan, B.J. and Webb, R.M. (1992) Rearrangement of Cadastral Boundaries to Facilitate Optimum Rural Land Use. Surveyors Board of Queensland.

Hannigan, B.J. and Webb, R.M. (1993) LIS Technology and the Process of Rural Reconstruction. AKCLIS funded Research Project/Report, December 1993.

Hannigan, B.J., Farmer, R.E., and Webb, R.M. (1994) Prospects for Using the Rural Adjustment Scheme to Implement the Concept of 'Remembrement' in the Mulga Lands. Technical paper presented at the Regional Land Use Planners Conference, Department of Lands, Brisbane, November 1994.

Hannigan, B.J., Farmer, R.E. and Webb, R.M. (1994b) Farm Reconstruction and the Rearrangement of Farm Boundaries. Public Seminar to Pittsworth Community and Local Authorities, Pittsworth, December 1994.

Hannigan, B.J. and Webb, R.M. (1995) Rearrangement of Property Boundaries to Facilitate Optimum Rural Land Use; Land and Water Resources R&D Corp., Final Report, June 1995.

Hannigan, B.J. and Farmer, R. (1995) Rearrangement of Farm Boundaries to Facilitate Beneficial Adjustment in Primary Industries. Final Report for Rural Industries Research and Development Corporation.

Hannigan, B.J. and Webb, R.M. (1996) Rearrangement of Property Boundaries to Facilitate Optimum Rural Land Use. Presented at 37th Australian Surveyors Congress, Perth, April 1996, 479-495pp.

Jinks, P.J. (1994) Linthorpe Valley Research Project Rural Economic Viability. Report prepared for QUT, School of Planning, Landscape Architecture, and Surveying.

King, C.J. (1957) An Outline of Closer Settlement in NSW. Department of Agriculture, NSW, Sydney.

Land Consolidation Act in the version of the promulgation of March 16, 1976 (Federal Law Gazette 1, 546p) as last amended by the Act of December 8, 1986 (Federal Law Gazette 1, 2191p) Federal Republic of Germany.

Morris, L. (1993) Historical Perspectives and the Protection of Viable Agricultural Land. Proceedings of a Rural Residential Seminar, Hodgson Creek Catchment Committee and Environment Institute of Australia, Toowoomba, August, 1993.

Osmond, R.J. (1985) Land Settlement in Queensland. Proceedings of the Agriculture and Conservation in Inland Queensland Conference, Dalby. Wildlife Preservation Society of Queensland, 1985.

Queensland Government (1991) Integrated Catchment Management. A Strategy for Achieving the Sustainable and Balanced Use of Land, Water and Related Biological Resources. Dept of Primary Industries, October, 1991.

QIDC (1991) Queensland Industry Development Corporation - Government Schemes Division. January, 1991.

Surveyor General (1886). Circular Memorandum to Mr Lic'd Surveyor. Requirements and general instructions in connection with the survey of Grazing Farms. Surveyor General's Brisbane, March 1886.

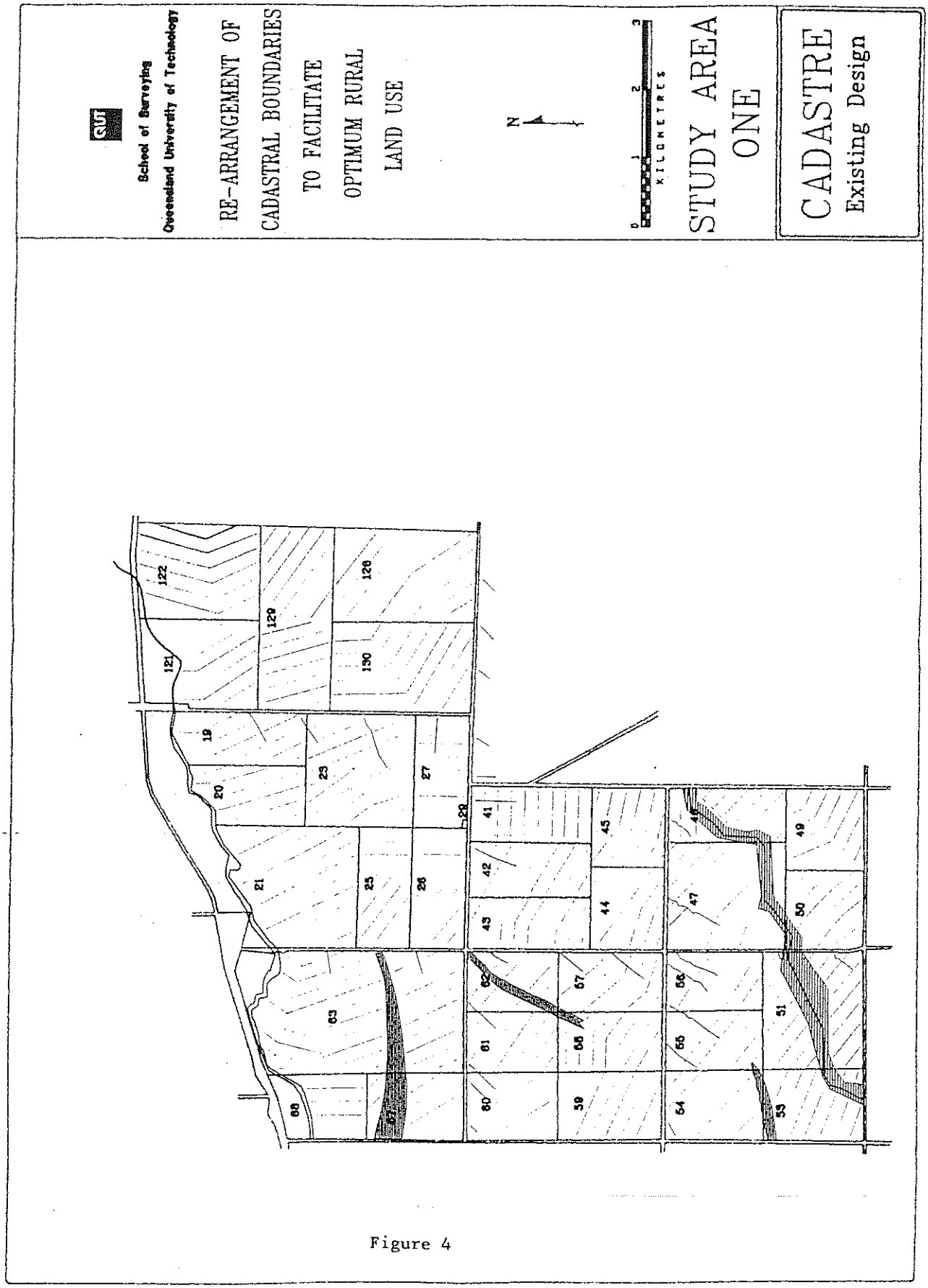
Tenkanen, A. (1994) Environmental Aspects of Land Consolidation. Proceedings of Commission 7 (Cadastre and Rural Land Management). FIG XX Congress in Melbourne, Australia, March 1994. Paper TS704.3

Walker, R.L. (1990) Expression of Interest. Regional Land Use Study, Eastern Downs Regional Organisation of Councils. Landcare Management Services, Toowoomba, June, 1990.

Waterson, D.B. (1968) Squatter, Selector and Storekeeper. Sydney University Press.

Webb, R.M. (1994) Developing a Geographic Information System for Resource Mapping and Farm Boundary Rearrangement in a Rural Darling Downs Catchment. Proceedings of Seminar: Farm reconstruction and rearrangement of farm boundaries. Pittsworth, December 1995, 51-82pp.

Wilson, B.G. (1992) A New Era for Land Information Management in Queensland. Proceedings of Aurisa 92 -Power to the People: The Community Information and Management. Gold Coast, November 1992, 8-15pp.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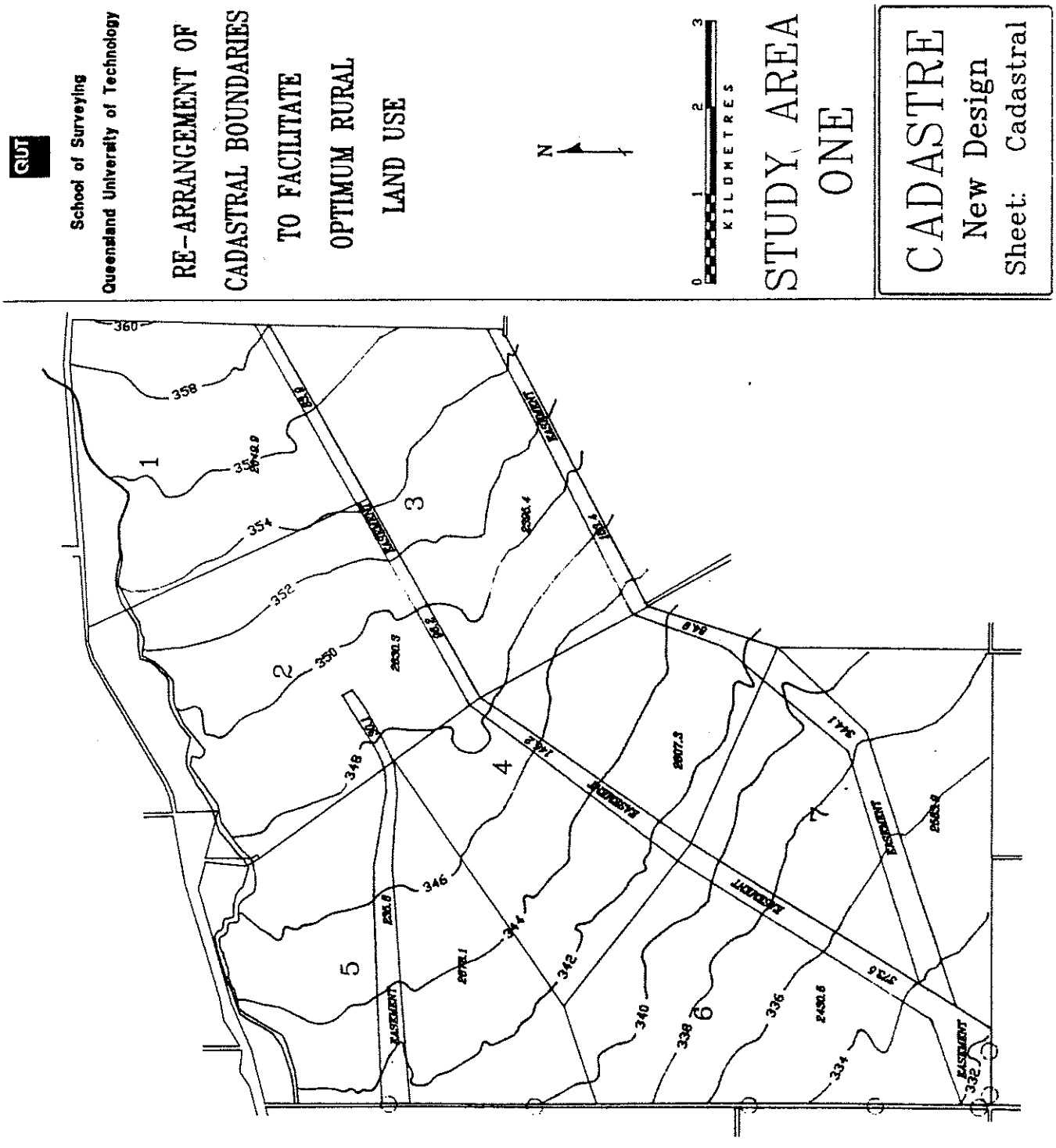
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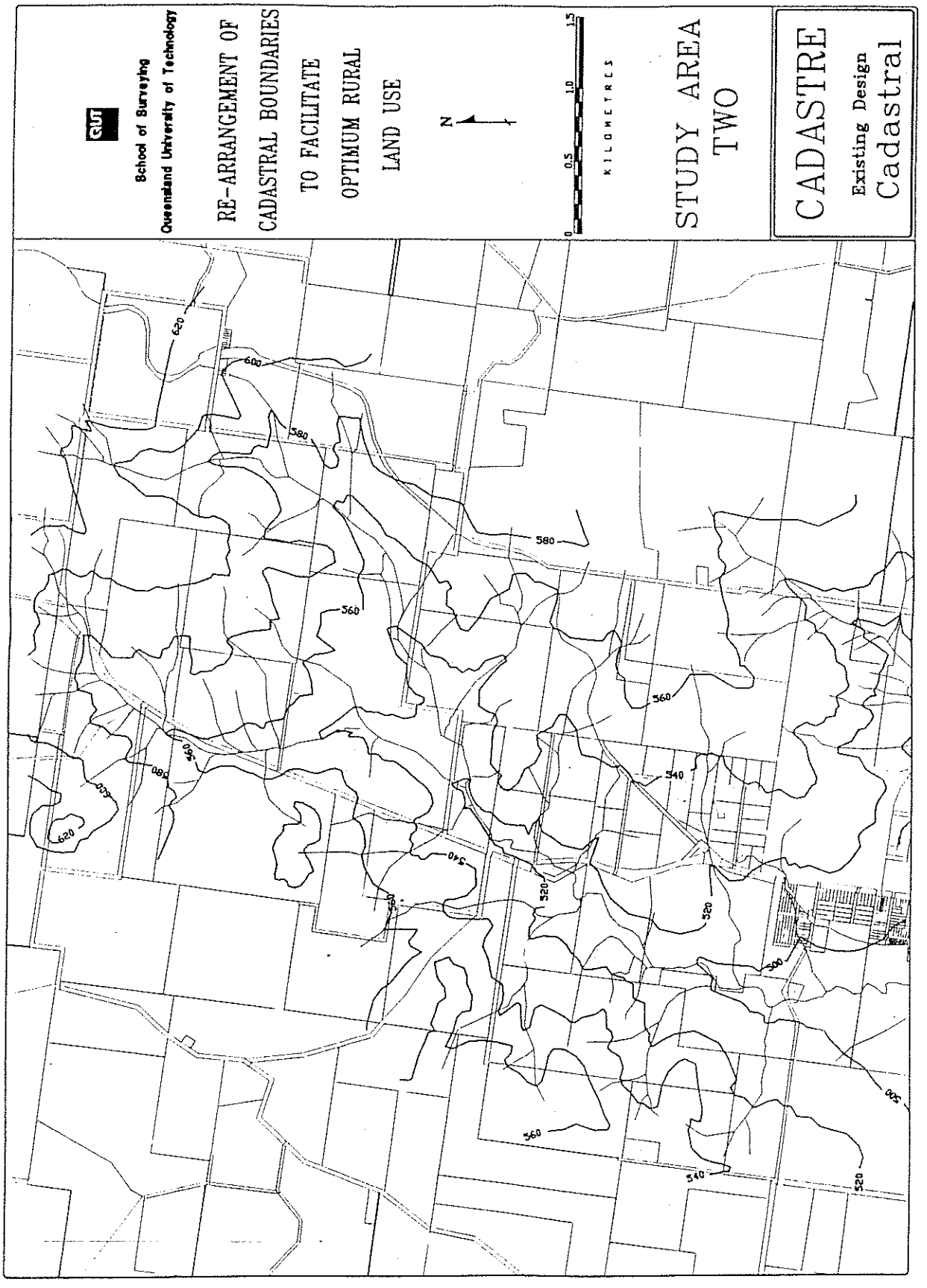
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OPTIMUM RURAL
LAND USE
N
0
0.5
1.0
1.5
KILOMETRES
STUDY AREA
TWO
CADASTRE
Existing Design
Cadastral

Figure 6

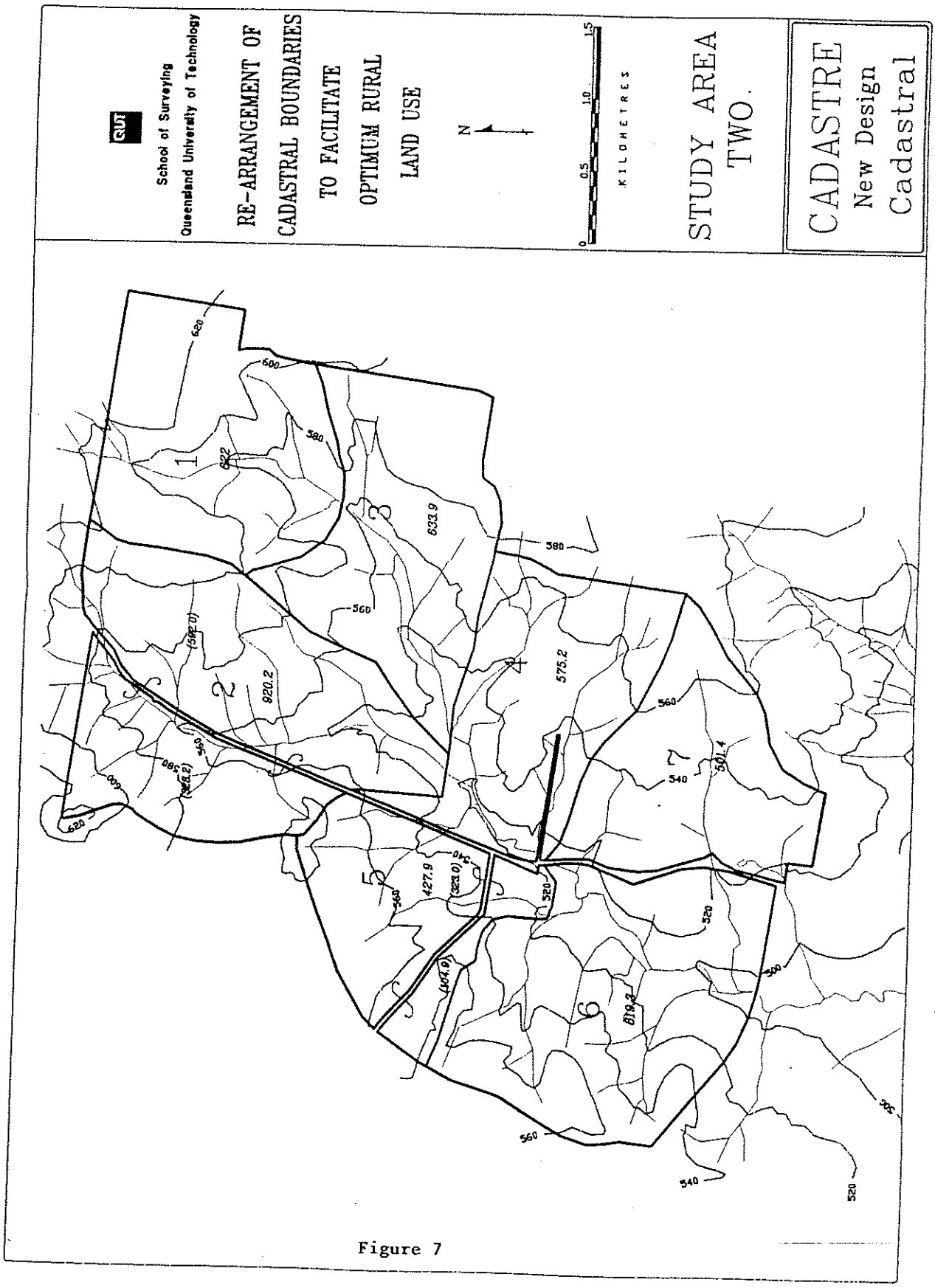

QUT
School of Surveying
Queensland University of Technology
RE-ARRANGEMENT OF CADASTRAL BOUNDARIES TO FACILITATE OPTIMUM RURAL LAND USE
N
0
0.5
1.0
1.5
KILOMETRES
STUDY AREA TWO.
CADASTRE
New Design
Cadastral
1
2
3
4
5
6
7
822
820.2
633.9
575.2
427.9
819.2
620
600
580
560
540
520
500

Figure 7

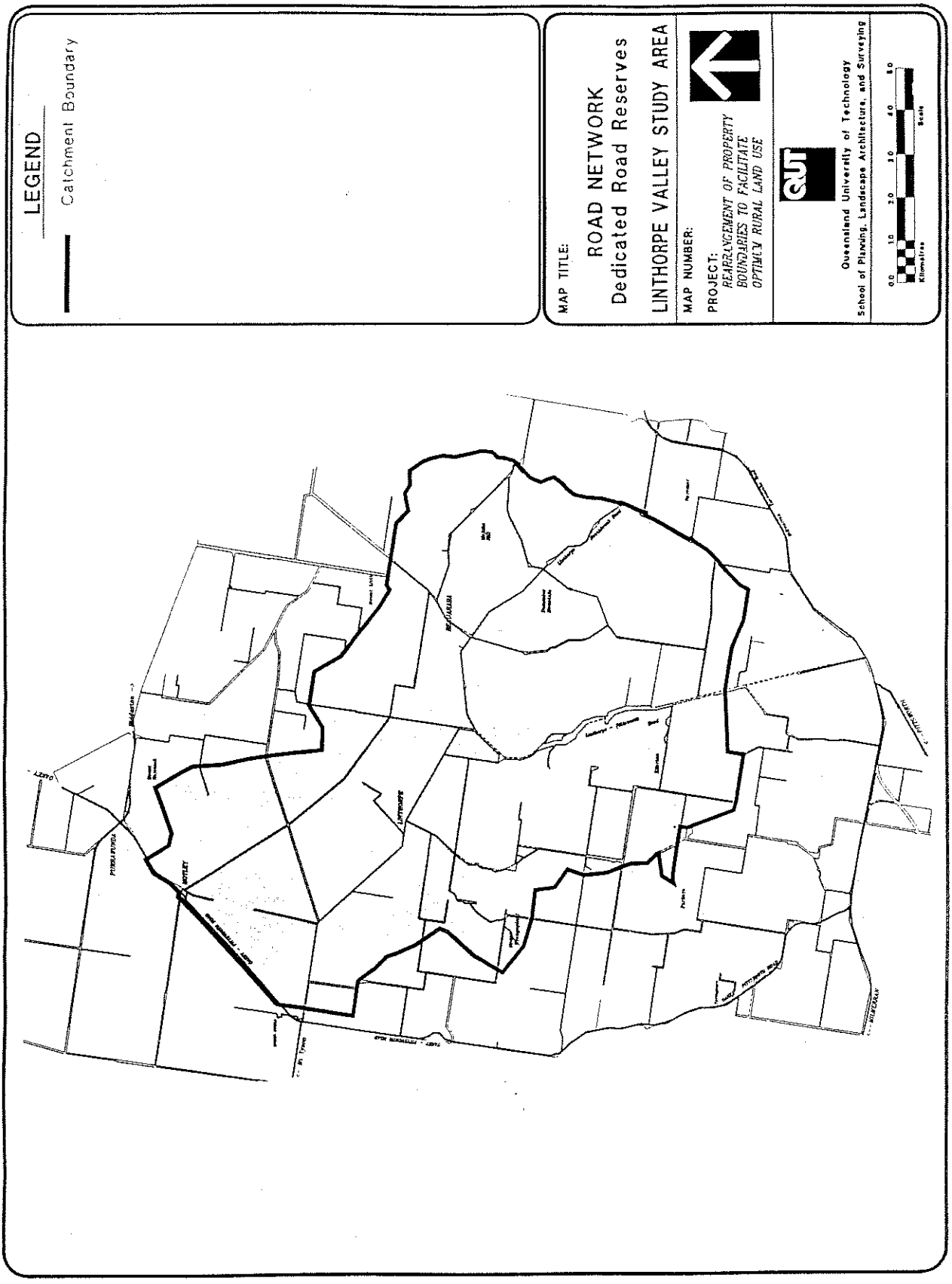

LEGEND
Catchment Boundary
MAP TITLE:
ROAD NETWORK
Dedicated Road Reserves
LINTHORPE VALLEY STUDY AREA
MAP NUMBER:
PROJECT:
REARRANGEMENT OF PROPERTY BOUNDARIES TO FACILITATE OPTIMUM RURAL LAND USE
Queensland University of Technology
School of Planning, Landscape Architecture, and Surveying
Kilometres
Scale

Figure 8

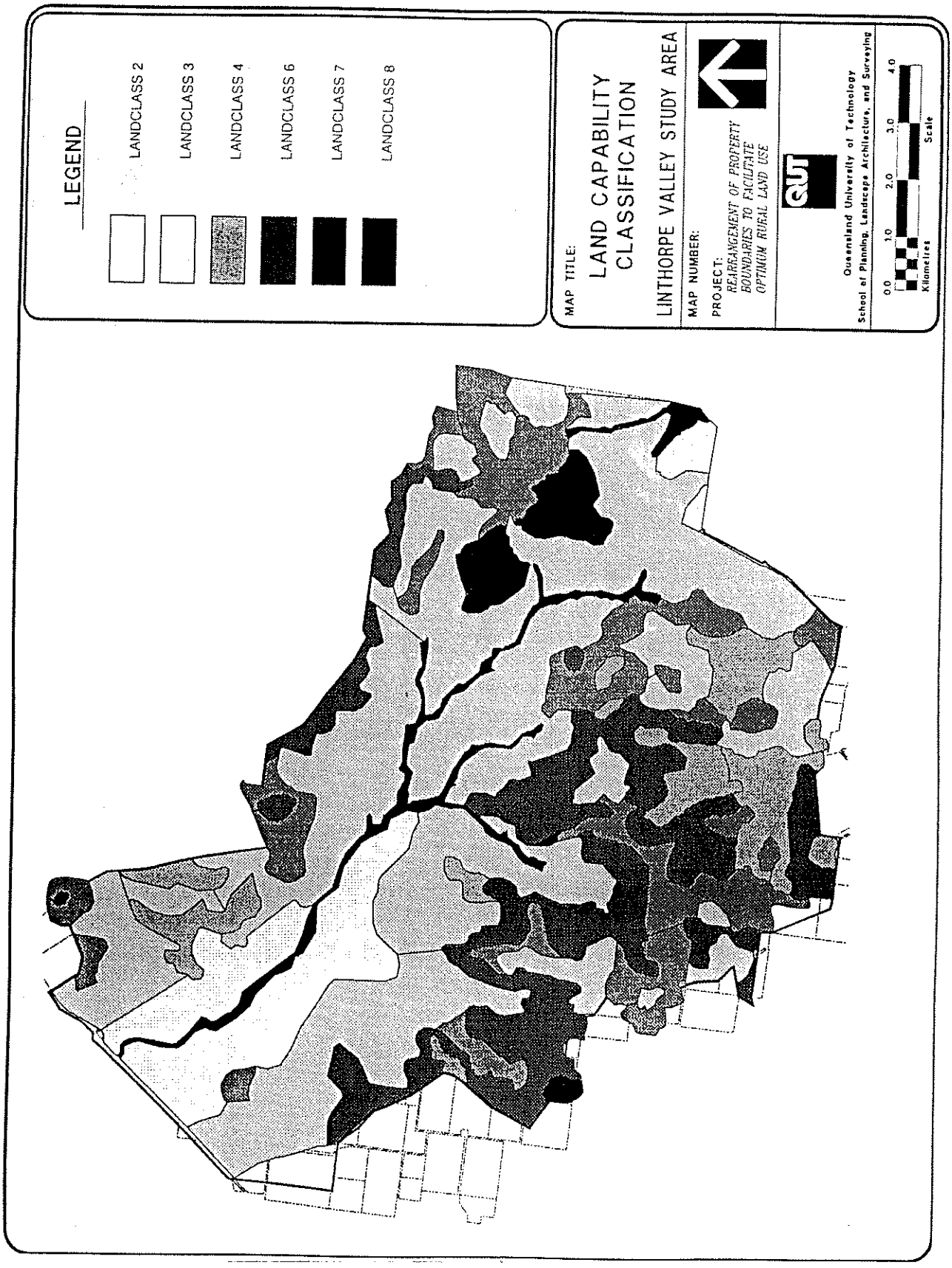

LEGEND
LANDCLASS 2
LANDCLASS 3
LANDCLASS 4
LANDCLASS 6
LANDCLASS 7
LANDCLASS 8
MAP TITLE:
LAND CAPABILITY CLASSIFICATION
LINTHORPE VALLEY STUDY AREA
MAP NUMBER:
PROJECT:
REARRANGEMENT OF PROPERTY BOUNDARIES TO FACILITATE OPTIMUM RURAL LAND USE
QUT
Queensland University of Technology
School of Planning, Landscape Architecture, and Surveying
0.0 1.0 2.0 3.0 4.0
Kilometres
Scale

Figure 9

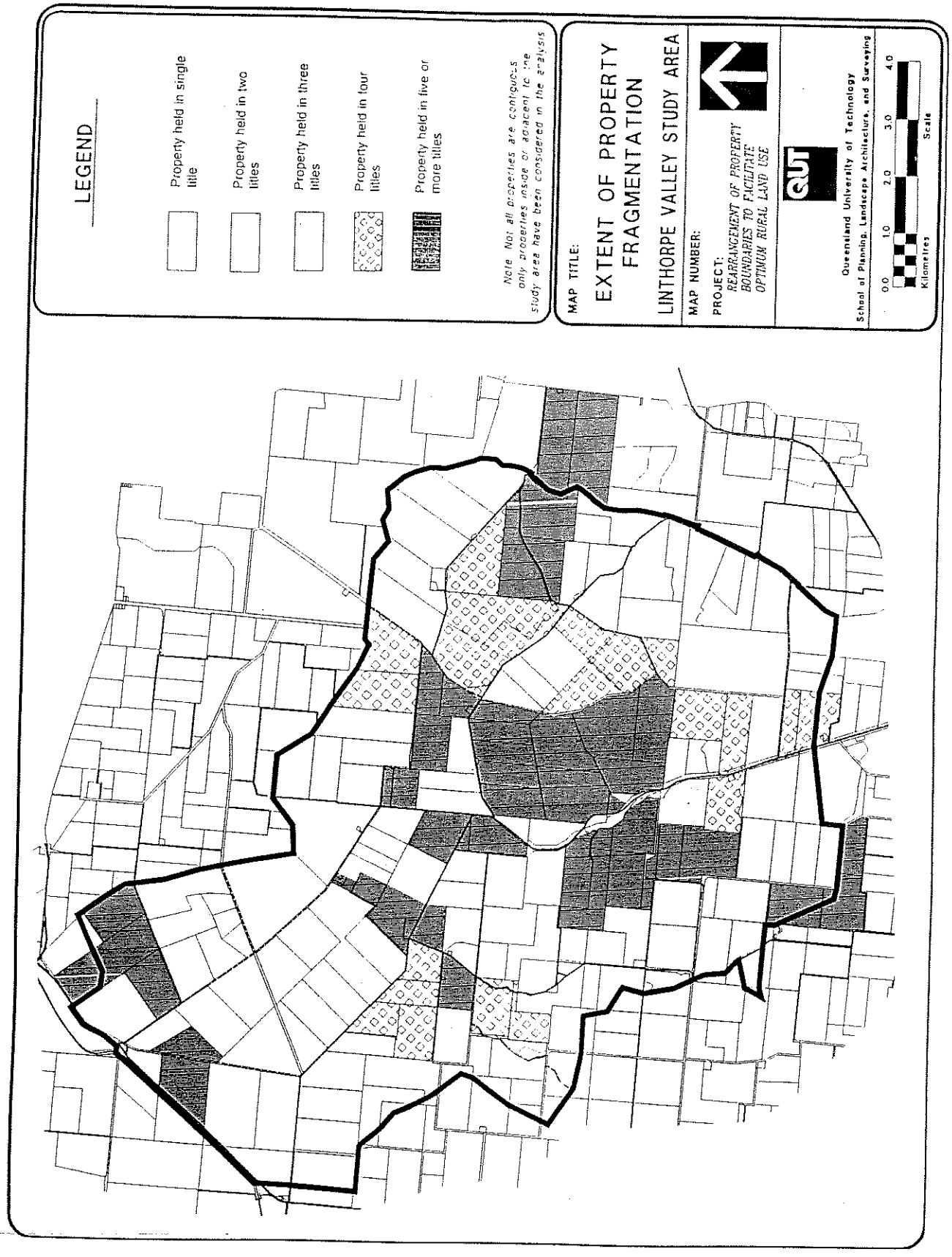
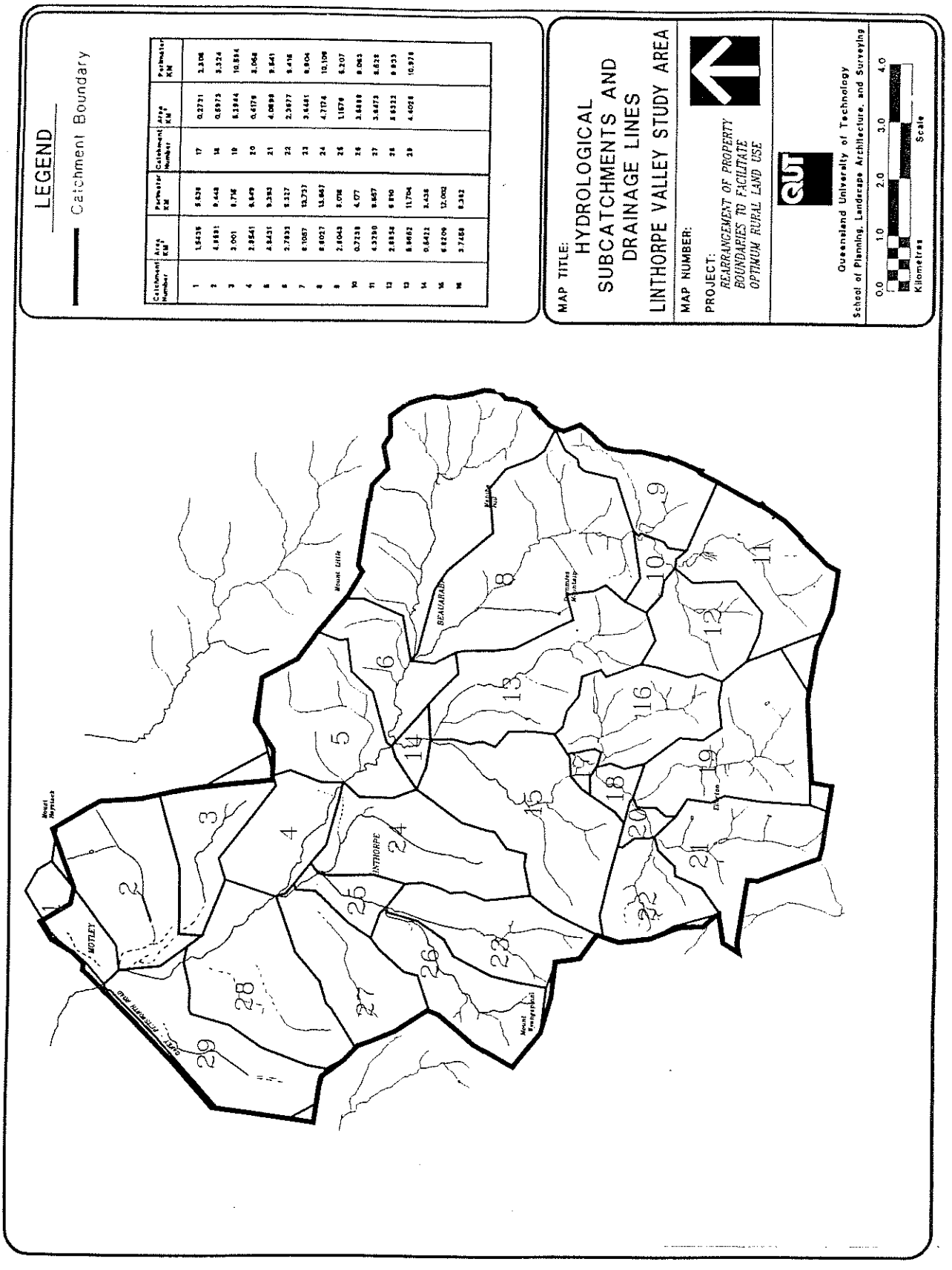

LEGEND
Property held in single title
Property held in two titles
Property held in three titles
Property held in four titles
Property held in five or more titles
Note: Not all properties are contiguous only properties inside or adjacent to the study area have been considered in the analysis
MAP TITLE:
EXTENT OF PROPERTY FRAGMENTATION
LINTHORPE VALLEY STUDY AREA
MAP NUMBER:
PROJECT:
REARRANGEMENT OF PROPERTY BOUNDARIES TO FACILITATE OPTIMUM RURAL LAND USE
QUT
Queensland University of Technology
School of Planning, Landscape Architecture, and Surveying
0.0 1.0 2.0 3.0 4.0
Kilometres
Scale

Figure 10



Catchment Number	Area KM²	Perimeter KM	Catchment Number	Area KM²	Perimeter KM
1	1.5435	5.539	17	0.2731	2.306
2	4.1881	9.448	18	0.8975	3.524
3	3.001	8.736	19	8.1944	10.594
4	2.8541	6.549	20	0.4179	2.056
5	4.8431	9.393	21	4.0899	8.841
6	2.7933	8.127	22	2.3077	6.416
7	8.1057	13.733	23	3.4481	8.804
8	8.8027	13.867	24	4.7174	10.108
9	2.6043	8.078	25	1.1679	6.207
10	0.7233	4.477	26	3.4818	8.063
11	4.3290	9.857	27	3.8473	8.828
12	2.8856	8.890	28	2.8533	8.853
13	8.9462	11.704	29	4.4051	10.328
14	0.8421	3.438			
15	8.8206	12.002			
16	3.7488	8.362			

Figure 11

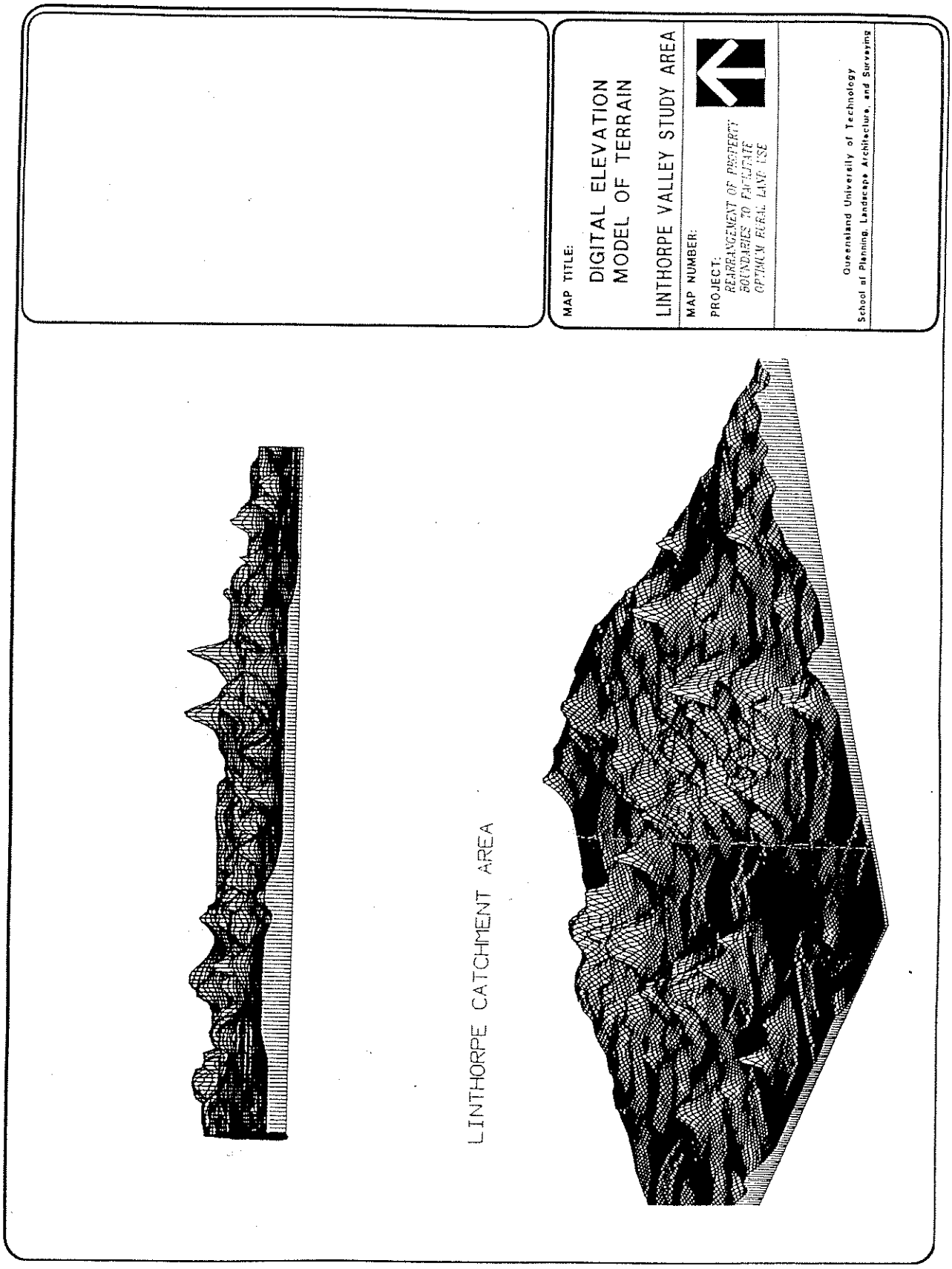

MAP TITLE:
DIGITAL ELEVATION MODEL OF TERRAIN
LINTHORPE VALLEY STUDY AREA
MAP NUMBER:
PROJECT:
REARRANGEMENT OF PROPERTY BOUNDARIES TO FACILITATE OPTIMUM RURAL LAND USE
Queensland University of Technology
School of Planning, Landscape Architecture, and Surveying
LINTHORPE CATCHMENT AREA

Figure 12

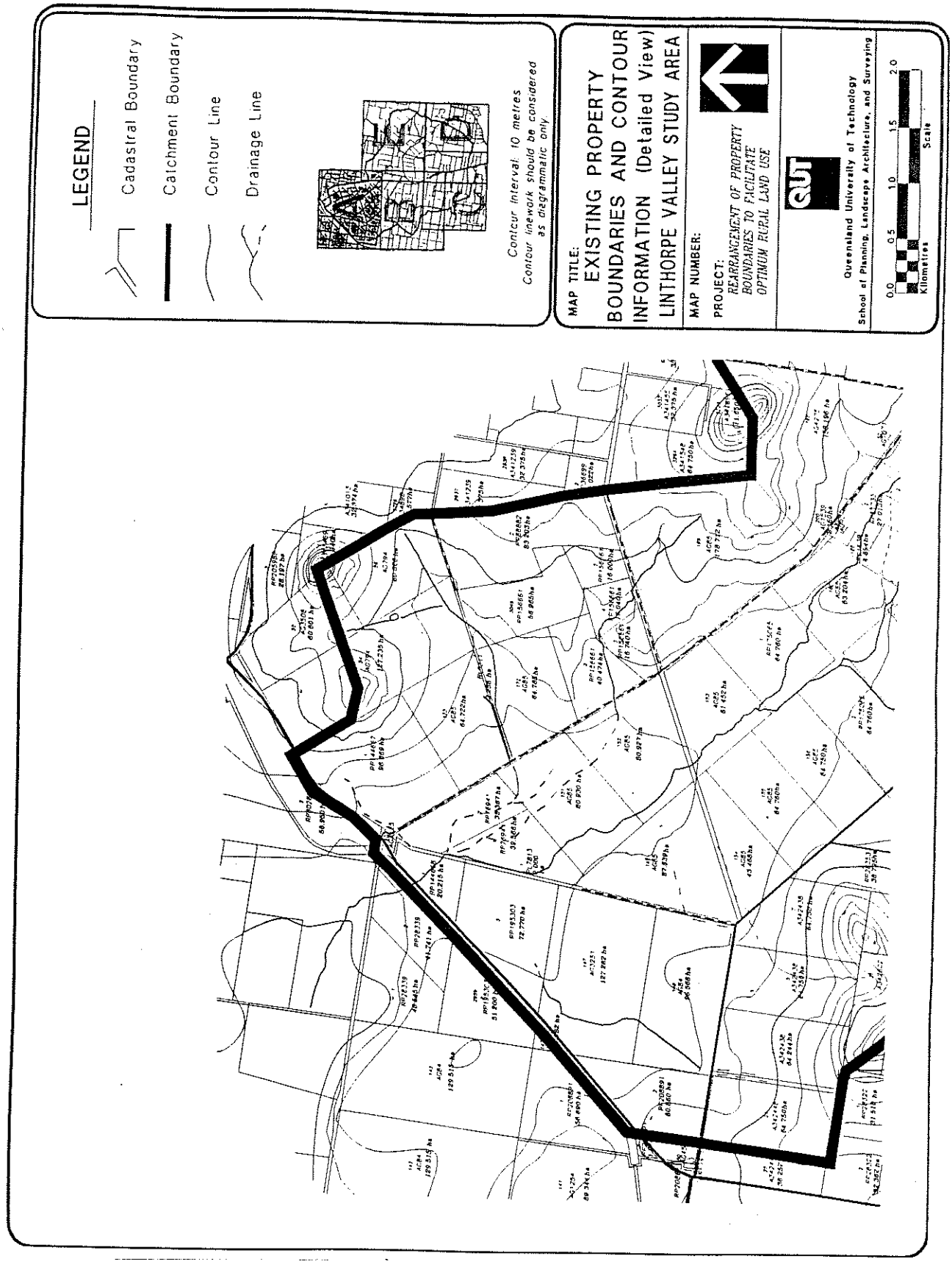
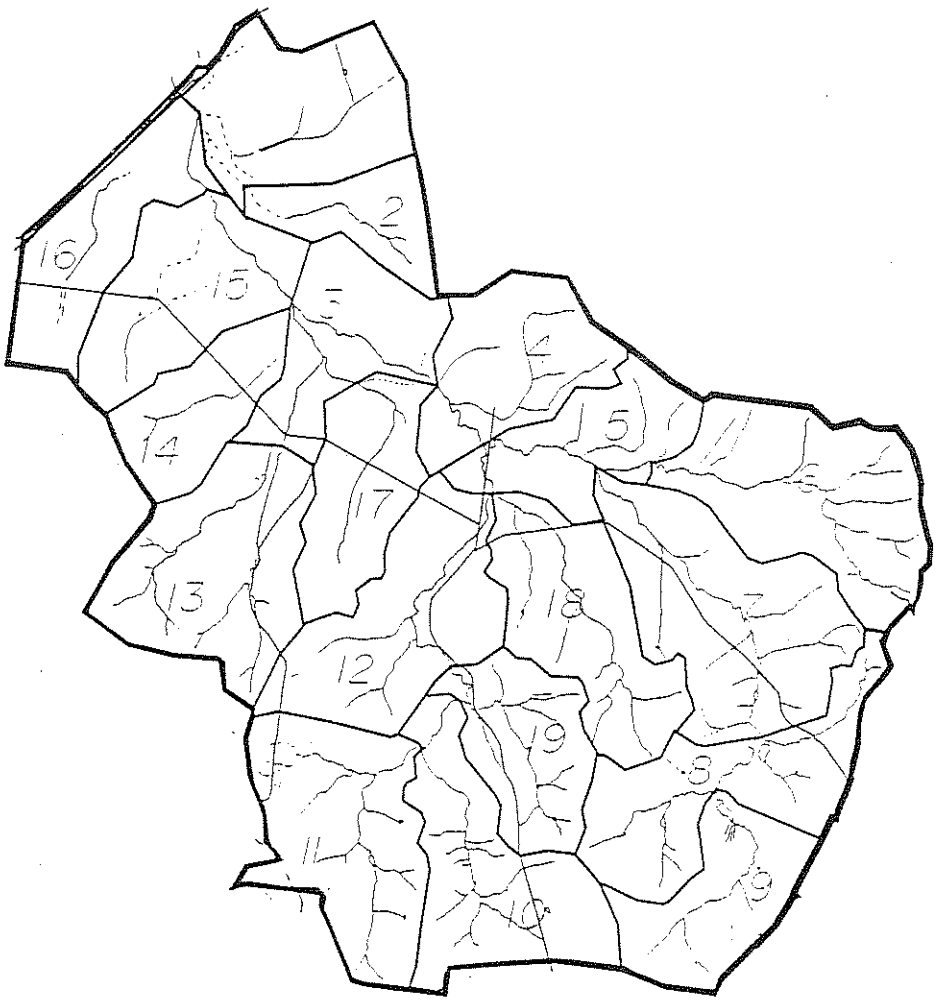

LEGEND
Cadastral Boundary
Catchment Boundary
Contour Line
Drainage Line
Contour interval 10 metres
Contour linework should be considered as diagrammatic only.
MAP TITLE:
EXISTING PROPERTY BOUNDARIES AND CONTOUR INFORMATION (Detailed View)
LINTHORPE VALLEY STUDY AREA
MAP NUMBER:
PROJECT:
REARRANGEMENT OF PROPERTY BOUNDARIES TO FACILITATE OPTIMUM RURAL LAND USE
QUT
Queensland University of Technology
School of Planning, Landscape Architecture, and Surveying
0.0
0.5
1.0
1.5
2.0
Kilometres
Scale

Figure 13



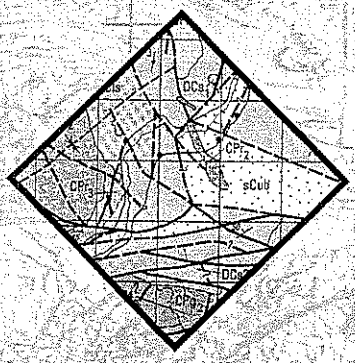
Total Area: 10,487 hectares
19 new farms with an average
area of 551 hectares (1360 acres)

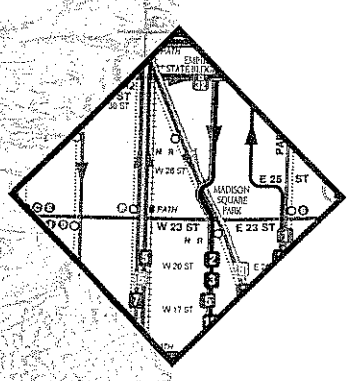
CONCEPT PLAN
REARRANGED
BOUNDARIES -
LINTHORPE VALLEY

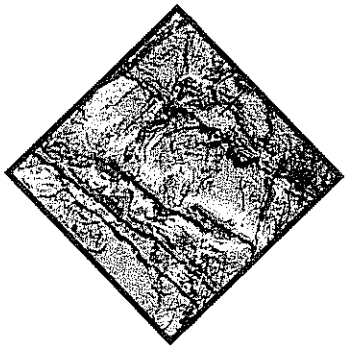
0 1 2 3 4
Kilometres

Figure 14

MAPPING FOR MANAGEMENT







National Convention Centre
Canberra, 22–26 September 1996

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